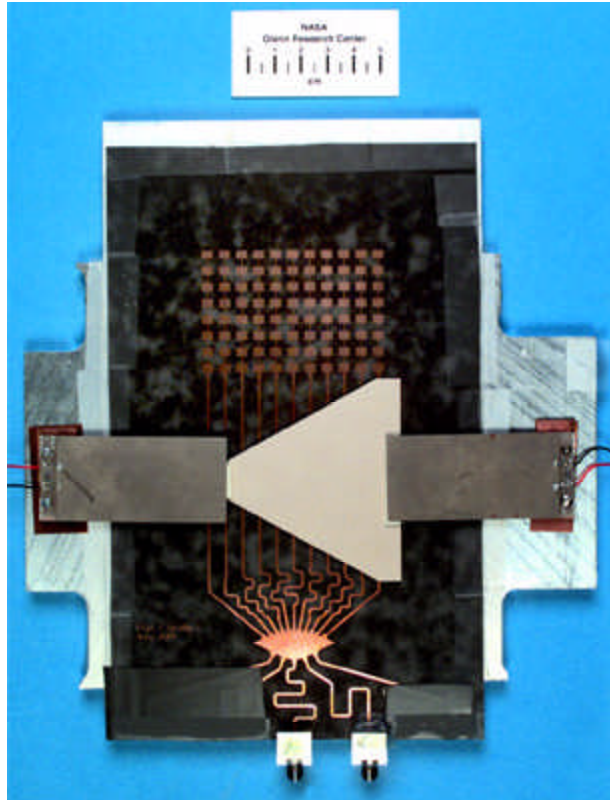


Multibeam Phased-Array Antennas Developed and Characterized

Fixed-formation microsatellites have been proposed for future NASA missions to lower costs and improve data collection and reliability (ref. 1). Achieving seamless connectivity communications between these satellites requires the use of multibeam array antennas. As a result of NASA Glenn Research Center's collaborative efforts with the University of Colorado and Texas A&M University, two prototype multibeam array antennas have been developed and demonstrated at Ka-band frequencies. These arrays are designed to be dual-beam, dual-frequency arrays, with two fixed scan beams at around $\pm 30^\circ$. They can be used in both ground and space systems for transmit and receive functions.

The first array, designed by the University of Colorado, is a space-fed lens (SFL) array that has significant advantages for multibeam applications. The spatial feed allows a multibeam configuration with only minor modification of the system design, avoiding the high complexity of the feed network required for conventional phased arrays. In addition, an SFL array generally has wider bandwidth, is lightweight, and can be fabricated at low cost. For large-array apertures, the SFL array has lower loss and can be easily optimized for a wide-angle scan (ref. 2). A photograph of the prototype SFL array is on the left.

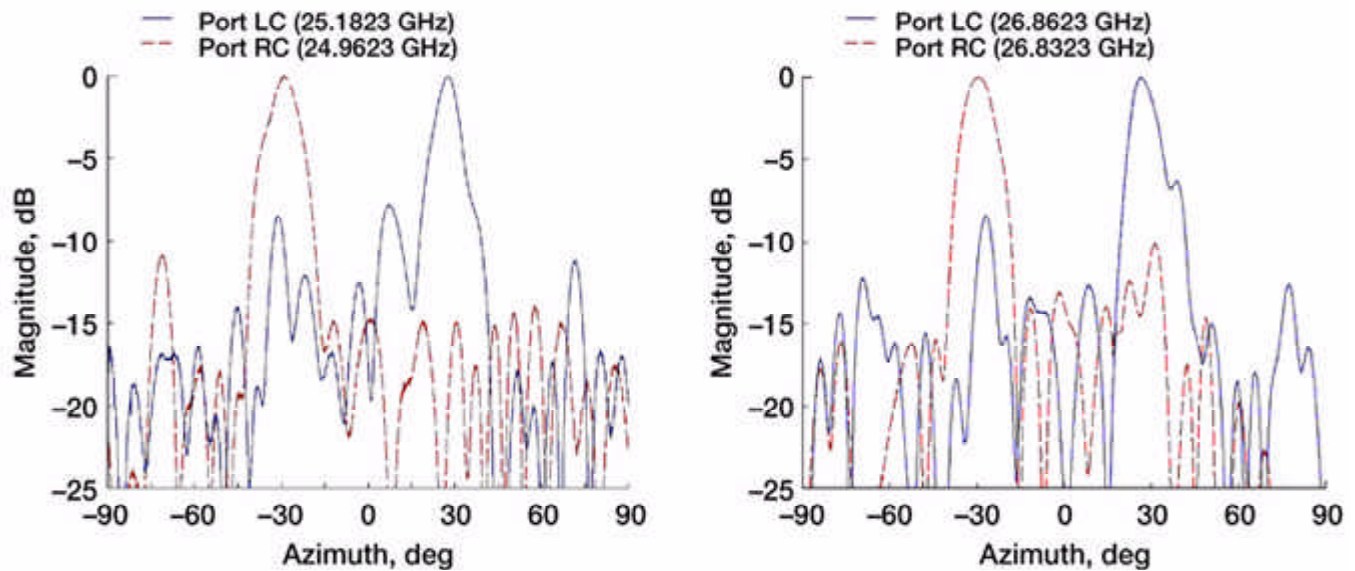




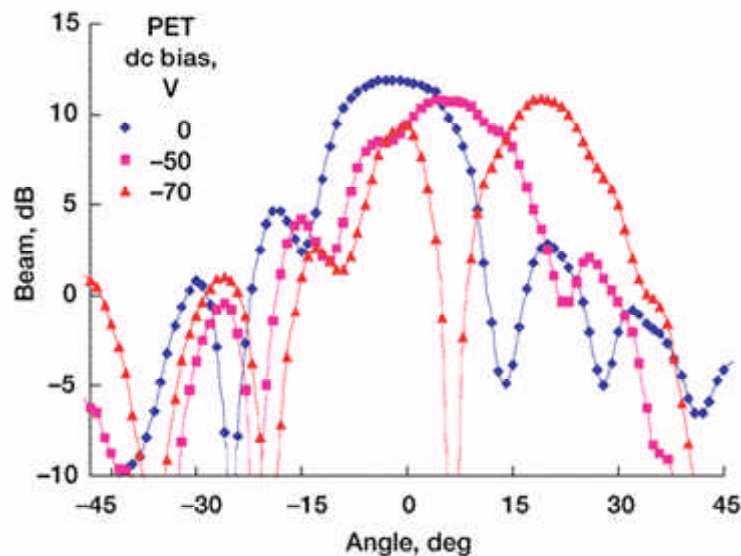
Left: Rear view of the SFL array with dual feeds. Right: PET array of patch antenna elements.

The second array, designed by Texas A&M, is a piezoelectric-transducer- (PET) controlled phased array. The array achieves beam steering by using two piezoelectric sheets to actuate a dielectric perturber over the feed lines effecting a change in the phase velocity of the lines. For multibeam operation, a Rotman lens beam former was used with two input sources to create two independent beams. A photograph of the PET array is on the right.

These two sets of graphs show the radiation patterns of the SFL and the PET arrays, respectively. Measured results exhibit excellent scan performance and close agreement with theory. Both arrays were also characterized in the compact range at Glenn; similar results were observed.



Radiation patterns for the SFL array. (Angular response of the Colorado lens.) Left: 24.7 GHz. Right: 26.7 GHz.



Radiation patterns for the PET array with different bias voltages at 31.1 GHz.

References

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